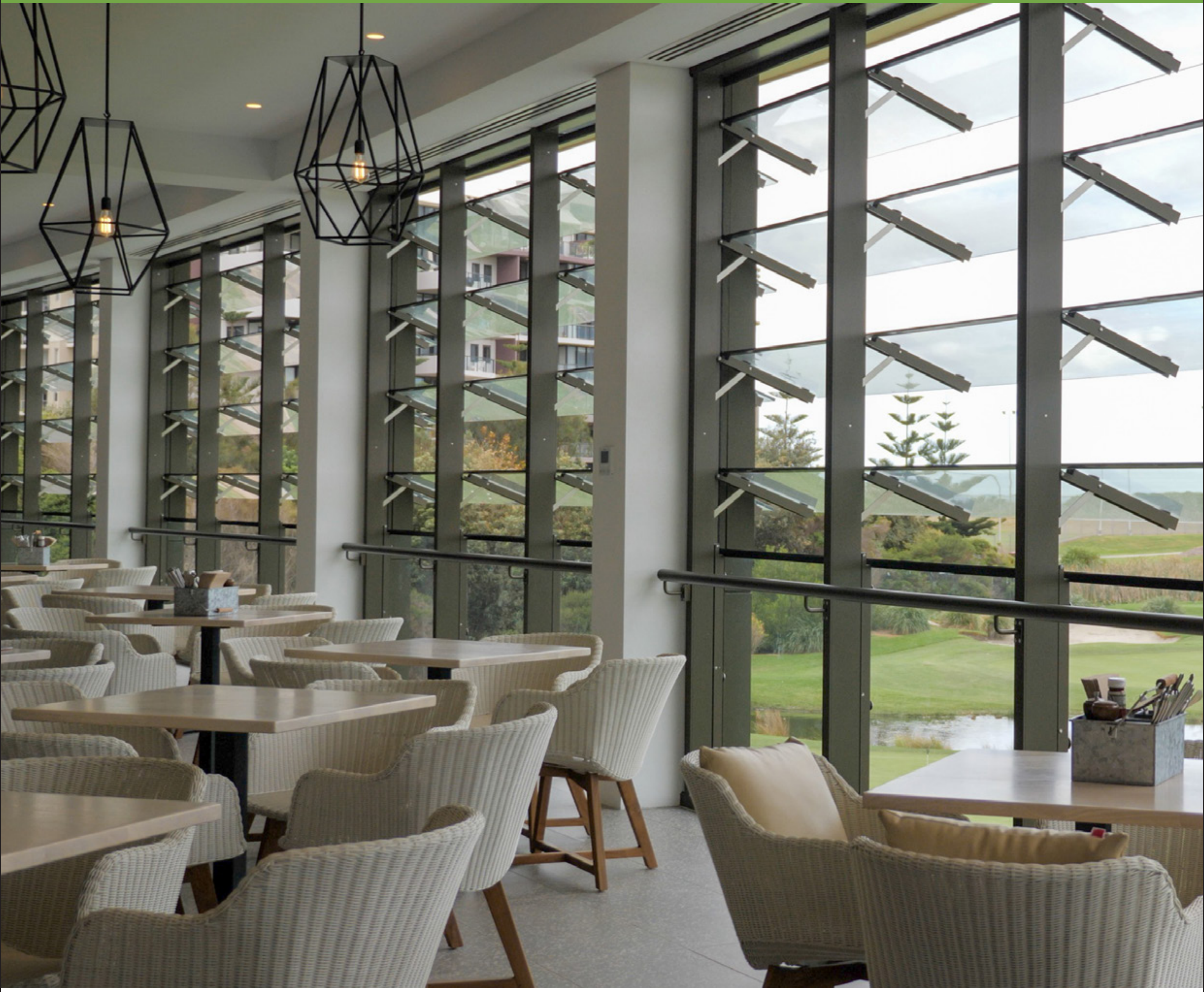
WINDOWS OF OPPORTUNITY

SPECIFYING AUTOMATIC WINDOWS FOR HEALTH, SAFETY AND SUSTAINABILITY



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INTRODUCTION

In Australia, reports indicate year-on-year increases in construction costs fueled by skills shortages and increasing labour and materials costs.[1] Global socio-economic conditions, particularly the COVID-19 pandemic, has led to supply-chain issues, putting stress on project budgets and schedules.

Despite these challenges, market expectations remain high. Designers, specifiers and builders must deliver high performing buildings that are healthy, sustainable and compliant with the *National Construction Code* (NCC) while navigating cost pressures and client demands.

With industry professionals needing to do more with less time and resources, several issues may impact the specification process. Limited knowledge of specialty fields, such as window automation, can lead to poor specification where the end result provides the lowest form of "compliance" as opposed to meeting the client's true intent and objectives.

This lack of knowledge, combined with the process of value management (referring to the process of defining, maximising and achieving "value for money" in construction projects),[2] often leads to clients not understanding what they are giving up or losing when they accept lesser, often domestic-oriented alternatives.

In some scenarios, poor specification of automated window systems can lead to basic elements such as auto-closing on loss of power, rain sensors and anti-pinch functions that protect children from harm being removed. Far too often, stakeholders do not know what is possible with window automation nor is it widely understood how such systems can be effectively and safely operated. With the right knowledge, designers and specifiers can turn automated windows into sophisticated natural ventilation systems through integration with building systems, environmental sensors and safe design.

In this whitepaper, we address this knowledge gap and take a closer look at the key considerations when designing and specifying automatic windows and natural ventilation systems, including how to address potential safety risks.

THE CASE FOR WINDOW AUTOMATION

IMPROVED ENERGY EFFICIENCY PERFORMANCE

Australia is among the highest per capita greenhouse gas-emitting countries in the world,[3] with buildings contributing approximately 25% of Australia's total emissions.[4] In 2019, the NCC incorporated changes to Section J to help curb rising greenhouse gas emissions and raise the efficiency of Australian buildings. Under JP1, the NCC requires buildings to have features that facilitate the efficient use of energy for sealing the building envelope against air leakage and, conversely, for utilising air movement to assist heating and cooling whenever appropriate.

Window automation allows this transition to occur seamlessly by increasing natural air flow whenever and wherever possible. This improves energy performance by enabling natural cooling of a building during warmer months. High quality window systems also prevent uncontrolled air leakage and heat loss, which otherwise lead to excess energy consumption due to the increased dependency on mechanical heating and cooling to moderate indoor temperatures.

Window automation can go further and enable a natural ventilation system that is capable of delivering either passive or mixed mode ventilation, space cooling and other advanced functions. An effective ventilation system can include an automatic window combined with rain and wind sensors. This design can be expanded with indoor air quality and external temperature sensors. These services can be programmed to automatically shut windows when mechanical heating or cooling is enabled. Alternatively, these services can automatically open windows when mechanical heating or cooling is switched off, allowing outdoor air flow to naturally regulate indoor temperatures.

INDOOR AIR QUALITY – IMPACT ON HEALTH, WELLBEING AND PRODUCTIVITY

Australians spend 90% of their time indoors whether in offices, schools, or at home.[5] Poor indoor air quality can result in adverse impacts on occupant health and environment that become a significant burden to the Australian economy.

Ventilation requirements for suitable indoor air quality are found in FV4 of the NCC. This provision requires buildings to have suitable openings to provide natural light and means of ventilation to maintain adequate air quality.

Natural ventilation systems improve indoor air quality by cycling out stale air and indoor pollutants. The movement of air through open windows prevents the accumulation of moisture that contributes to bacteria, mould and fungi growth. Increasing the outdoor ventilation rate in a building also helps maintain comfortable indoor temperatures and reduces indoor humidity, both of which contribute to occupant comfort. Most mechanical heating and cooling systems introduce only a small percentage of fresh outdoor air into a building.[6]

Research has established the impact of indoor air quality on health, wellbeing and productivity. It is accepted that poor indoor air quality can lead to health issues including sensory and skin irritation, neurotoxic symptoms, hypersensitivity, and odour and taste symptoms. An excess of these symptoms is sometimes referred to as "sick building syndrome".[7] Long-term exposure to indoor contaminants like formaldehyde and asbestos can lead to serious health issues such as cancer and respiratory disease.[8]

In commercial and academic settings, poor indoor air quality has been demonstrated to cause reduced cognitive performance and productivity. An American study showed employees working in environments with improved ventilation performed 61% better on cognitive tasks than in standard office conditions.[9] In the academic context, studies have found that ventilation rates corresponded with academic performance – as ventilation rates increased, so did the proportion of students passing standardised tests.[10]

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WINDOW AUTOMATION AND NATURAL VENTILATION SYSTEMS: DESIGN CONSIDERATIONS

Window automation systems work best when each component works together to deliver optimum performance and functionality. Poor specification and co-ordination can lead to operational inefficiency, maintenance issues and other short comings. Some examples include:

- Specifying multiple “transformers” scattered throughout the ceilings of a building poses future maintenance issues compared to a centralised commercial solution.
- Providing limited ability to interface with other systems on the project, such as security systems that automatically close windows during certain periods and air conditioning systems that do not run when windows are open to conserve energy.

KEY COMPONENTS: ACTUATOR, CABLING AND CONTROLS

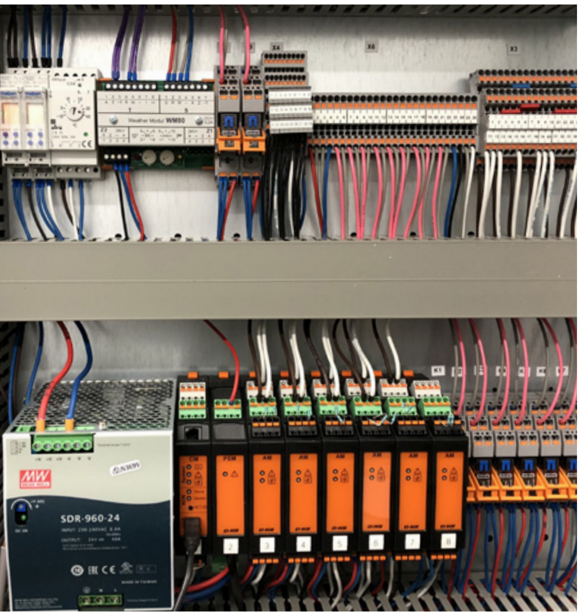
Window automation systems can incorporate almost any type of window. Louvre and awning windows, or a combination of both, make up the majority of the automatic windows in Australia and New Zealand. Parallel opening and casement windows can also be automated as well as roof lights.

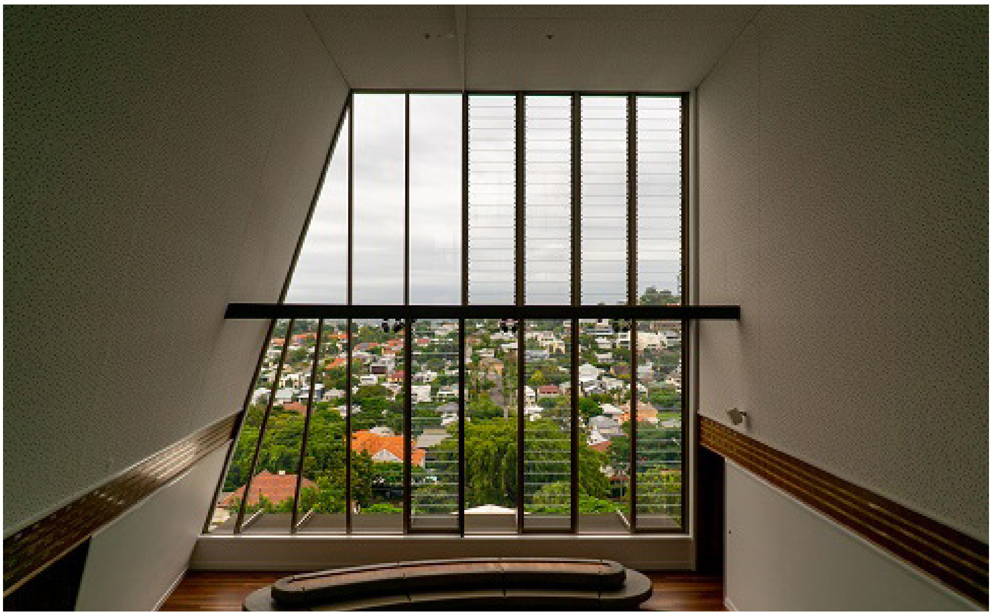
Window automation involves a three-part mechanical solution, each with its own set of considerations:

- The **actuator (or drive)** is responsible for physically opening and closing the window. Different types of windows require specific types of actuators. When selecting actuators, designers and specifiers must consider fitness for purpose, compliance with wind load requirements, noise level requirements, safety considerations (such as anti-pinch) and size. Acoustics are especially important in specific settings, such as classrooms, where a noisy actuator can be very disruptive. The industry standard drive operates at 65dB, whereas industry-leading actuators can operate at less than 35dB, which is the sound level experienced in a library.
- **Cabling** should be selected with reference to the desired functionality, window location, control panel location and the actuator. These factors should be considered early in the process as cabling comprises a significant proportion of costs in commercial installations. Effective design utilising digital technology can reduce implementation costs in areas such as field cabling.
- **Controls** should provide a functional interface between the user and the actuator. Leading manufacturers offer control solutions that can switch between automatic, time-controlled and/or manual opening and closing as well as other advanced ventilation options.

Determining whether a solution is suitable for the proposed application is an involved process especially for commercial applications. A specialist company should be engaged to examine factors such as ultimate limit state (ULS) wind loads and requirements for water tightness and air leakage and select actuators that are fit for purpose. Multiple drives may be needed to withstand negative wind pressures that can lift the corners of a window, compromising window performance. If a single drive is fitted to reduce cost without proper consideration of the above factors, the overall system may not perform as expected.

As an example, unwanted air leakage can negatively affect the energy efficiency of a building as mechanical heating and cooling costs increase.





INTERNAL AND EXTERNAL SENSORS

Natural ventilation systems can include environmental sensors which work together to automate the operation of the windows according to preset values. Air quality sensors (AQS) monitor CO_2, humidity and temperature to enable the automatic regulation of ventilation to maintain optimal thermal comfort at all times. This means that when conditions are unfavourable for natural ventilation the system will call for various modes of heating or cooling.

Most schools have a requirement for indoor air quality or CO_2 sensors that are integrated with a natural ventilation system. To address this requirement, CO_2 sensors can be installed in classrooms so that windows automatically open to purge stale air and then close when indoor air quality levels are acceptable. When windows are opened, the integrated system can temporarily shut off heating and cooling to conserve energy.

Integration with a building's smoke relief system can be a requirement for commercial and public buildings. In the event of a fire, an alarm is sent to the control panel, prompting the automation system to open windows in the building to allow heat, smoke and gasses to dissipate. These systems should be certified to ISO 21927 and include failsafe measures such as 72-hour battery backup and status monitoring of the entire system including the actuators to ensure the system is always in a state of readiness.

INTEGRATION

When designing a natural ventilation system, consider how window automation can integrate with building management systems, security systems, mechanical cooling and heating systems, and other ventilation systems. For example, an automatic window can be programmed to close when the building is not occupied. Additional functions like "night purging", which enables overnight pre-cooling of an indoor space, and automatic closure on power loss should also be considered.

Utilising digital technology, drives can now communicate with the control panel, enabling significant improvements in interfacing with third party building systems. This new functionality can provide users the ability to know the status of every drive to reduce maintenance costs, be alerted when windows are open or closed, and remotely access systems that are installed in regional projects. This additional functionality can make building management even easier.

MINIMISING SAFETY RISKS

As louvres and awning windows become more commonplace, designers and specifiers must be aware of the safety risks associated with the operation of automatic windows, especially where they are used in public spaces such as schools, universities or hospitals. When an awning window is closing, the aluminium frame creates a guillotine mechanism. Center and end pivot louvres also pose a crushing risk. If safety concerns are not properly accounted for, there is a real threat of injury to users of the space, especially children.

In general, awning windows and centre pivot glass louvres operate with lower force actuators than end pivot louvres, where the forces needed to open and close the blades is significantly higher. A typical commercial quality actuator on an awning window is approximately 200-250N, which equates to 20-25kg of force, but domestic louvre systems of an end-pivoting design for example require significantly more force to open and close, up to 1200N. In a worst case scenario, a user can have his or her fingers crushed between glass edges with 120kg of force applied if appropriate hardware is not specified correctly (e.g. without anti-pinch) or has fallen foul of the value management process during the tender stage.

In Europe, these safety concerns are addressed by the *Machine Directive (ED)2006/42/EC (MD)*, which requires machinery to be designed and constructed to meet common minimum European requirements for safety.[11] Under the MD, a risk assessment must be performed during building planning to assess and implement safeguards mitigating the risk potential of an automatic window. This risk assessment covers the following:

- risk areas that pose a crushing or collision hazard;
- height of windows (windows situated within easy reach, especially for children, pose a greater safety risk than higher-situated windows);
- installation context (offices, residential spaces, schools and hospitals all have different safety considerations); and
- the different risks associated with centrally-operated automatic windows and manually-operated windows respectively.

In Australia and New Zealand, a similar risk assessment should be undertaken when designing window automation systems. A common safety feature is an anti-pinch mechanism that stops the movement of the window if an obstacle is in its path. Specifiers should undertake the risk assessment and implement safeguards during the design stage. The specifier could be held liable and may find themselves without insurance cover where they have knowingly specified or approved products which do not conform to industry best practice.

EBSA

Based in Sydney, Melbourne, Brisbane and Auckland, EBSA Pty Ltd is a leading Australian manufacturer and supplier of window automation and louvre installations, combining functionality and aesthetics.

Driven by a strong focus on sustainability, health and safety, EBSA leverages the latest in window and automation technology to deliver window systems that support the natural flow of light and air in commercial, residential and educational buildings. The company's commitment to quality and innovation has made them the preferred choice among Australia's architects and specifiers designing within these sectors.

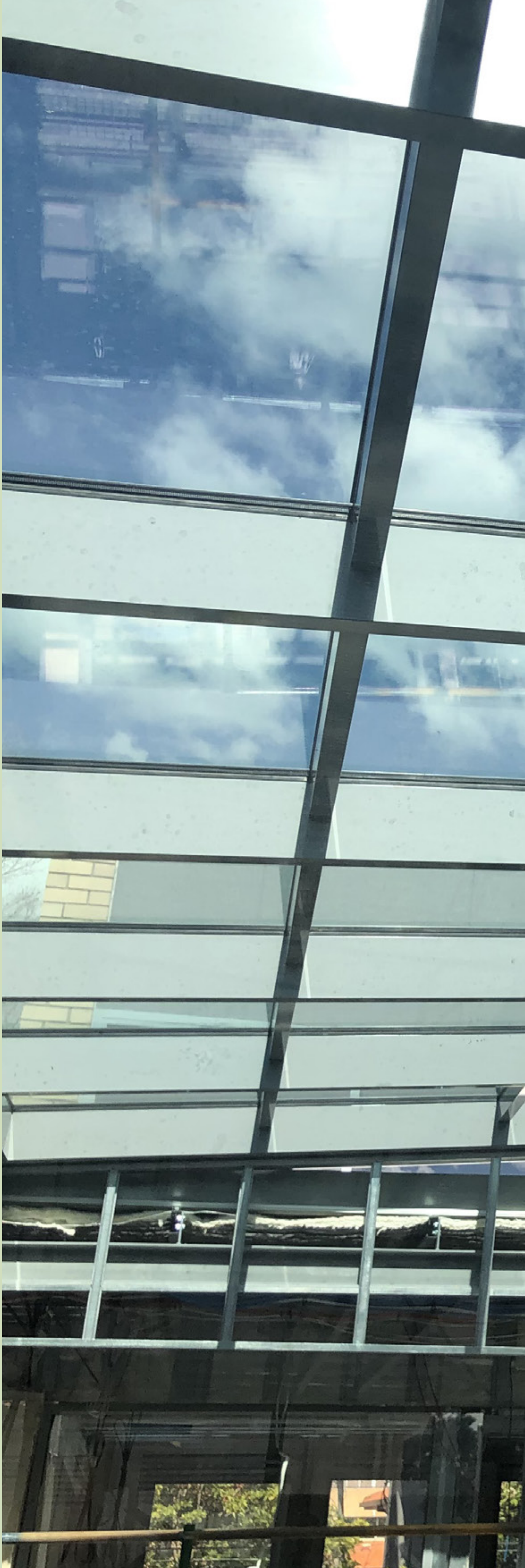
ENGINEERED FOR SAFETY: D+H MECHATRONIC

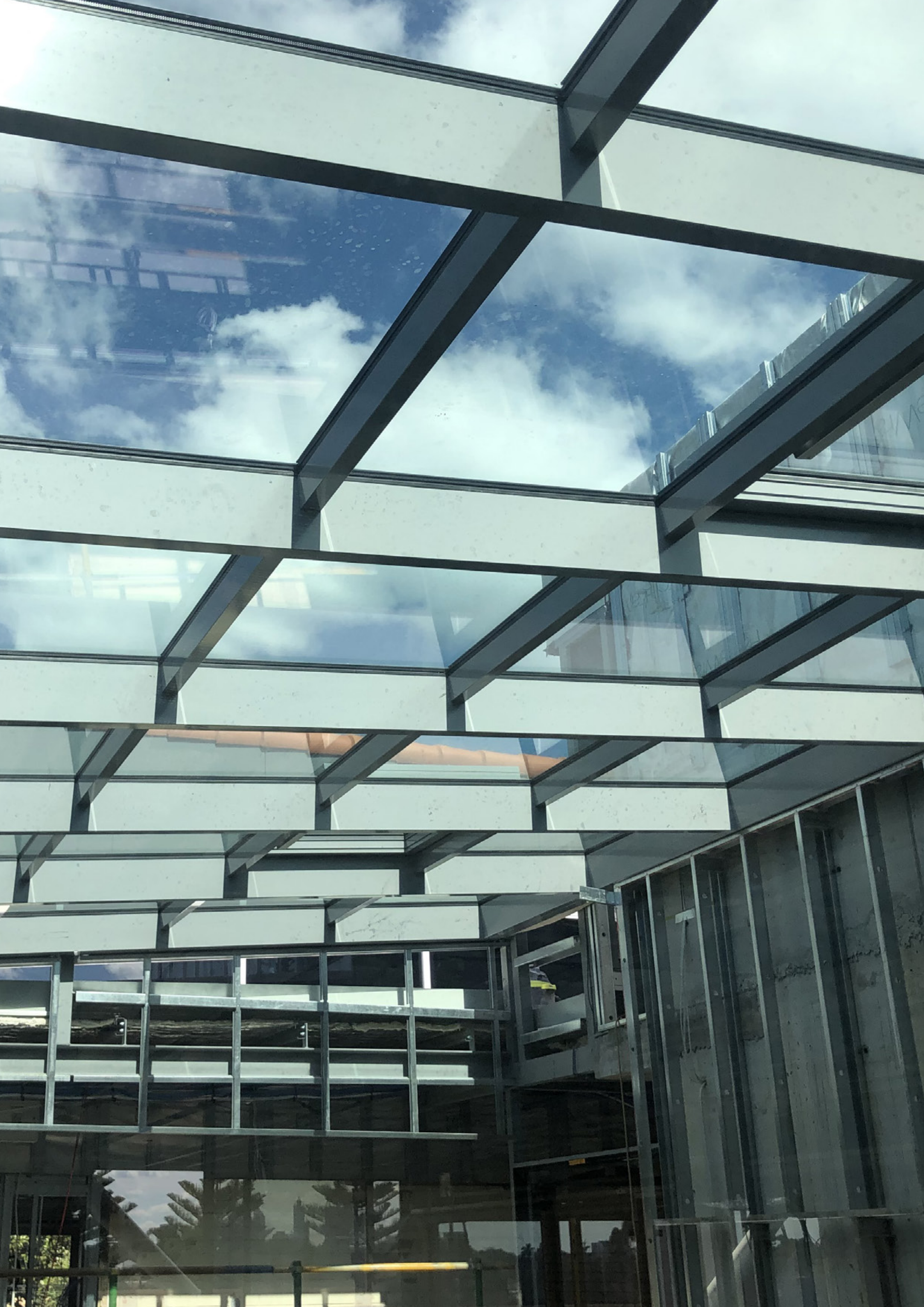
EBSA are proud to offer D+H Mechatronic's range of window automation products. Preferred over other systems on the market for their quality, every D+H product has been designed, produced and physically tested by D+H Mechatronic to the highest performance and safety standards. This dedication to quality has given D+H Mechatronic the reputation it has today as the market leader in intelligent window automation solutions for over 25 years in Australia.

The D+H product range is broken into the following product groups:

- **Control Panels**, including the GVL Series for natural ventilation, and the RZN and CPS-M controllers to enable smoke ventilation;
- **Sensors** for wind, rain, air quality including temperature, and others; and
- **Drives** (actuators), such as chain drives, rack and pinion drives, locking drives and louvre drives, now featuring digital communication to the control panels.

Selecting from the D+H range of window automation products with the guidance of EBSA's expert consultants, clients can design efficient mixed ventilation solutions and smoke and heat ventilation systems that meet all performance and safety requirements.





REFERENCES

[1] Tan, Su-Lin. "Construction costs to keep rising: RLB." Australian Financial Review. https://www.afr.com/property/construction-costs-to-keep-rising-rlb-20190122-h1ac0y (accessed 21 June 2020).

[2] Designing Buildings Ltd. "Value management in building design and construction." Designing Buildings Wiki. https://www.designingbuildings.co.uk/wiki/Value_management_in_building_design_and_construction (accessed 21 June 2020).

[3] Climate Watch. "Australia." Climate Watch Data. https://www.climatewatchdata.org/countries/AUS?calculation=PER_CAPITA&source=43 (accessed 21 June 2020).

[4] Martek, Igor and M Reza Hosseini. "Buildings produce 25% of Australia's emissions. What will it take to make them 'green' – and who'll pay?" The Conversation. https://theconversation.com/buildings-produce-25-of-australias-emissions-what-will-it-take-to-make-them-green-and-wholl-pay-105652 (accessed 21 June 2020).

[5] Australian Government. "Indoor air." Department of Agriculture, Culture and the Environment. https://www.environment.gov.au/protection/air-quality/indoor-air (accessed 21 June 2020).

[6] United States Environment Protection Agency. "Indoor Air Quality (IAQ)." EPA. https://www.epa.gov/indoor-air-quality-iaq/improving-indoor-air-quality (accessed 21 June 2020).

[7] Above n 5.

[8] Ibid.

[9] Sander, Libby. "Research shows if you improve the air quality at work, you improve productivity." The Conversation. https://theconversation.com/research-shows-if-you-improve-the-air-quality-at-work-you-improve-productivity-76695 (accessed 21 June 2020).

[10] Haverinen-Shaughnessy, U, DJ Moschandreas and RJ Shaughnessy. "Association between substandard classroom ventilation rates and students' academic achievement." International Journal of Indoor Environment and Health, Vol. 21 Issue 2 (2011): 121-131.

[11] European Commission. "Machinery." European Commission. https://ec.europa.eu/growth/sectors/mechanical-engineering/machinery_en (accessed 21 June 2020).

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